Numb. 36.

PHILOSOPHICAL TRANSACTIONS.

Monday, *June* 15. 1668.

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An Account

Of a Controverſy betwixt Stephano de Angelis, *Profeſſor of the Mathematicks in* Padua, *and* Joh. Baptiſta Riccioli *Jeſuite*; *as it was communicated out of their lately Printed Books, by that Learned Mathematician Mr.* Jacob Gregory, *a Fellow of the* R. Society.

R*Iccioli* in his *Almageſtum Novum* pretends to have found out ſeveral new demonſtrative Arguments againſt the Motion of the Earth. *Steph. de Angelis*, conceiving his Arguments to be none of the ſtrongeſt, taketh occaſion to let the world ſee, that they are not more eſteem'd in *Italy*, than in other places. *Manfredi*, in behalf of *Riccioli*, endeavours to anſwer the Objections of *Angeli*, and this latter replyes to *Manfredi*'s Anſwer. The ſubſtance of their diſcourſe is this following.

Although the Arguments of *Riccioli* be many, yet the ſtrength of them conſiſts chiefly in theſe *three:*

The *firſt*.

Multa corpora gravia, dimiſſa per Aerem, in Plano Æquatoris exiſtentem, deſcenderent ad Terram cum Velocitatis Incremento reali & notabili, & non tantùm apparenti. Sed ſi tellus moveretur motu diurno tantùm circa ſui centrum, nulla corpora gravia, dimiſſa per Aerem, in Plano Æquatoris exiſtentem, deſcenderent ad Terram cum velocitatis incremento reali ac notabili, ſed tantùm cum apparenti. E. *Tellus aut non movetur, aut non movetur diurno tantùm motu.*

The *ſecond*.

Si Tellus moveretur motu diurno, aut etiam annuo, multò debilior eſſet ictus Globi bombardici exploſi in Septentrionem aut Meridiem, quàm ab Occidente in Orientem. At conſequens eſt falſum. E. *& antecedens.*

The *third*.

Si Tellus diurna revolutione moveretur, Globus argillaceus unciarum 8. *ex altitudine Romanorum pedum* 240. *per aerem quietum dimiſſus, obliquo deſcenſu in Terram delaberetur abſque incremento reali ac phyſico velocitatis, vel certè nunquam tanto, quanta eſt proportio percuſſionis ac ſoni per caſum ex dicta altitudine facti. Sed poſterius eſt abſurdum.* E. *& prius.*

In Anſwer to the *firſt* of theſe Arguments, *Angeli* denieth the *Minor*, which *Riccioli* pretends to prove thus;

Si Tellus moveretur ſolo diurno motu, aliquod Grave, dimiſſum ex Turris vertice C in Plano Æquatoris exiſtentis, deſcriberet ſuo motu naturali portionem lineæ CTI, quæ eſſet ad omnem ſenſum circularis.

V. Fig. I.

This *Angeli* denies, ſhewing by Computation, that *Riccioli* his Obſervation proveth no ſuch thing. For (ſaith *Angeli*) according to *Riccioli*, in one ſecond of an hour the weight deſcends 15 foot; in 2 ſeconds, 60 foot; in 3 ſeconds 135 foot; and ſo continually the ſpaces from the beginning are in duplicate proportion of the Time from the beginning; and, according to the

Fig. 1

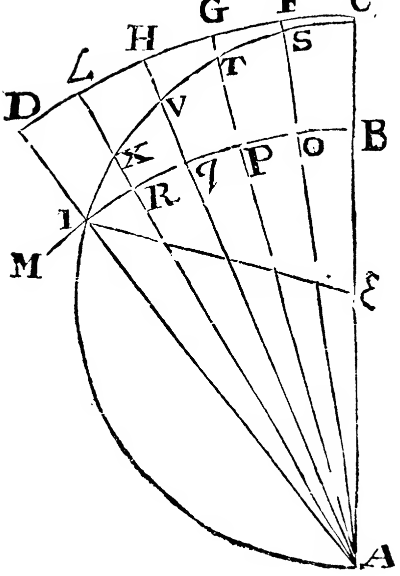
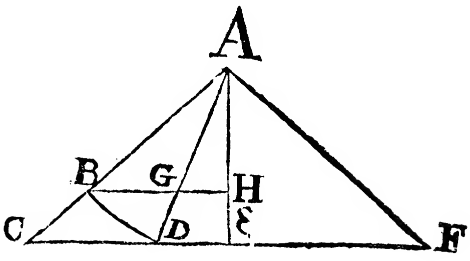


Fig. 2



ſame Author; AB (the *ſemi-diameter* of the Earth) is of 25870000 foot, and BC (the height of the Tower of the *Aſinelli* in *Bononia)* of 240 foot; and therefore AC is 25870240, which hath the ſame proportion to FS, 15 foot, to wit, ye fall in one ſecond, which AC in parts 20000000000 hath to FS 11595 $\genfrac{}{}{0pt}{}{54356}{224189}$; but ſuppoſing, with *Riccieli*, CSIA a ſemi-circle, FS is 53 parts, of which AC is 10000000000: Hence concludeth *Angeli*, that CSIA is no wayes near to a *ſemi-circle*; which is moſt ſure, if ſo be the weight fall not to the Center of the Earth preciſely in 6 hours: For, in this caſe of *Riccioli*, the weight falls to the Center of the Earth in 21 *minutes* and 53 *ſeconds.*

Manfredi in his Anſwer for *Riccioli* affirms, that *Angeli* underſtands not the *Rule* of *Three*, in giving out FS. for 11596 $\frac{54356}{224189}$, of which AC is 20000000000: And *Angeli* in his Reply affirms his Analogy to be ſo clear, that there can be nothing ſaid more evident than it ſelf to confirm it; referring in the mean time the further determination to Geometers.

Angeli might have anſwer'd *Riccioli*'s Argument, granting the weight to move equally in a *ſemi-circle*, by diſtinguiſhing his *Minor* thus;

Nulla Corpora gravia deſcenderent ad Terram cum velocitatis incremento reali ac notabili, ſi Velocitas computetur in circumferentia ſemi-circuli; *Minor propoſitio eſt vera. At non computatur ita Motus deſcenſivus: nam hic motus æqualis in circumferentia ſemi-circuli CIA. componitur ex motu æquali in quadrante CD, & motu accelerato in ſemidiametro mobili* CA; *& hic motus acceleratus in ſemidiametro eſt verus & ſimplex motus deſcenſivus; in qua acceptione Minor propoſitio eſt falſiſſima, &* Riccioli *etiam experientiis contraria.* But it ſeems, that *Angeli* anſwereth otherwiſe, to make *Riccioli* ſenſible, that CIA is no ſemicircle; concerning the nature of which Line they debate very much throughout the whole diſcourſe.

The *ſecond* Argument is much inſiſted upon by *Angeli*, to make his ſolution clear to vulgar capacities; but the ſubſtance of all is, That the *Canon*-ball hath not only that violent motion, impreſſed by the Fire, but alſo all theſe motions proper to the Earth, which were communicated to it by the impulſe received from the Earth:

for,

for, the Ball, going from Weſt to Eaſt, hath indeed two impulſes, one from the Earth, and another from the Fire; but this impulſe from the Earth is alſo common to the mark, and therefore the Ball hits the mark only with that ſimple impulſe, received from the Fire, as it doth being ſhot towards the North or South; as, *Angeli* doeth excellently illuſtrate by familiar examples of Motion.

To *Riccioli* his *third* Argument *Angeli* anſwereth, deſiring him to prove the ſequel of his *Major*, which *Riccioli* doeth, ſuppoſing the *curve*, in which the heavy body deſcends, to be compoſed of many ſmall right lines; and proving, that the motion is almoſt always *equal* in theſe lines; and after ſome debate, concerning the equality of motion in theſe right lines, *Angeli* anſwers, that the *equality* of *motion* is not ſufficient to prove the *equality* of *percuſſion* and ſound, but that there is neceſſary alſo *equal angles* of *incidence*; which in this caſe he proveth to be very *unequal*. To illuſtrate this more, let us prove, that, other things being alike, the proportion of two percuſſions is compoſed of the direct proportion of their *velocities*, and of the direct proportions of the *Sines* of their angles of incidence. *Supponamus autem ſequens principium, nempe, quod percuſſiones (cæteris paribus,) ſint in directa proportione cum velocitatibus, quibus mobile appropinquat planum reſiſtens.* Fig. 2da. *Sit planum* CF, *ſintque duo mobilia omni modo æqualia, & ſimilia, quæ motu æquali accedant à puncto* A. *ad planum* CF, *in rectis* AD, AF: *dico, percuſſionem in puncto* D *ad percuſſionem in puncto* F. *eſſe in ratione compoſita ex ratione velocitatis in recta* AD. *ad velocitatem in* AF, *& ex ratione ſinus anguli* ADE *ad ſinum anguli* AFE. *Ex puncto* A *in planum* CF, *ſit recta* AE *normalis, ſitque recta* AC *æqualis rectæ* AF, *&* AB *æqualis rectæ* AD, *& planum* BGH, *parallelum plano* CF: *ſupponamus mobile, prioribus ſimile & æquale, moveri æqualiter in recta* AC, *eadem velocitate, qua movetur mobile in recta* AD: *quoniam plana* BGH, CF, *ſunt parallela, & motus in recta* AC *eſt æqualis, igitur mobile eadem velocitate accedit ad planum* BH, *qua ad planum* CF, *& proinde percuſſiones in punctis* B, C, *ſunt æquales; atque percuſſio in puncto* D, *eſt ad percuſſionem in puncto* B, *ut recta* AE *ad rectam* AH, *ſeu (ob æquales rectas* AD, AB) *ut ſinus anguli* ADE *ad ſinum anguli* ABH, quod ſic probo; *velocitas mobilis in recta* AD, *eſt æqualis*

velo-

velocitati mobilis in recta AB, *ipſi* AD *æquali, & ideo eodem tempore perficitur utraque recta* AD, AB; *& proinde eodem tempore perficiuntur acceſſiones ad plana reſiſtentia* AE, AH; *ideoque velocitates acceſſionum ad plana reſiſtentia ſunt in directa ratione* AE *ad* AH, *atque ideò percuſſio in puncto* D. *eſt ad percuſſionem in puncto* C. *in eadem ratione* AE *ad* AH; *nempe ut Sinus anguli incidentiæ* ADE. *ad ſinum anguli incidentiæ* ACE, *vel* AFE. *Quoniam autem rectæ* AC, AF, *æqualiter inclinant ad planum* CF, *mobilia in rectis* AC, AF, *accedunt ad planum* CF, *in eadem proportione qua moventur in rectis* AC, AF; *& ideo percuſſio in* C *eſt ad percuſſionem in* F *in ratione velocitatis motus in* AC *ſeu in* AD *ad velocitatem motus in* AF; *At demonſtratum eſt antè, percuſſionem in puncto* D *ad percuſſionem in puncto* C, *eſſe in ratione ſinus anguli* ADE *ad ſinum anguli* AFE, *& nunc demonſtratum eſt, percuſſionem in puncto* C *eſſe ad percuſſionem in puncto* F, *ut velocitas motus in* AD *ad velocitatem motus in* AF. *Igitur ex* 5. *defin.* 6. *Elementorum, percuſſio in* D, *eſt ad percuſſionem in* F, *in ratione compoſita ex ratione ſinus anguli incidentiæ* ADE, *ad ſinum anguli incidentiæ* AFE, *& ex ratione velocitatis in* AD *ad velocitatem in* AF; quod demonſtrare oportuit. *Neminem moveat, quod hæc demonſtratio adſtricta ſit motibus æqualibus in lineis rectis & planis reſiſtentibus; eſt enim vera in omni caſu: nam, cum percuſſiones fiant in puncto, in hoc coincidunt rectum, curvum, æquale, & inæquale; ſi autem in punctis percuſſiones non fiant, de illis non poteſt dari conſideratio geometrica, ſed judicandus eſt concluſionis defectus ſecundum defectum materiæ à conditionibus requiſitis, ſicut ſemper fieri debet, dum demonſtrationes geometricæ corpori phyſico applicantur.*

In *Angeli* his reply to *Manfreddi*, he maketh mention of an Experiment, which (as was related to him by a *Swediſh* Gentleman) had been made with all due circumſpection by *Carteſius* to prove the *Motion* of the *Earth*. The experiment was; He cauſed to be erected a Canon perpendicular to the Horizon; which being 24 times diſcharged in that poſture, the Ball did fall 22 times towards the *Weſt*, and only *twice* toward the *Eaſt*.